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(54) AN ELECTRO-MOTIVE DRIVE FOR AN AUTOMATIC WASHING MACHINE

(71) We, SIEMENS AKTIENGESELLSCHAFT, a German company, of Berlin and Munich, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an electro-motive drive for an automatic washing machine.

According to this invention there is provided an electro-motive drive for an automatic washing machine, the drive comprising an AC series-wound commutator motor, provided with controllable semiconductor switch means via which the motor can be coupled with a single-phase supply, there being control means coupled with the switch means for controlling the speed of the motor, and a single-pole switch device connected between outer terminals of the armature of the motor, the drive being such that, to transfer from a higher to a lower speed in use of the drive, the armature is short-circuited by closing the switch device, this device connecting the exciter winding of the motor so that it is fed from the supply via the semiconductor switch means, the exciter current being controllable via the semiconductor switch means for achieving a desired variation of braking torque with speed.

The drive could be such that, with the switch device closed, the exciter current is controlled as a function of speed so that the braking torque due to the motor operating with a short-circuited armature and with its exciter winding supplied via the semiconductor switch means increases with decreasing speed.

Alternatively, the exciter current could be controlled so that the braking torque due to the motor operating with a short-circuited armature and with its exciter winding supplied via the semiconductor switch means alters in accordance with a predetermined function of time.

The exciter current could, in the first alternative, be such that with the armature short-circuited, the armature current is constant during braking.

The invention will now be described by way of example with reference to the accompanying drawing, in which:

Figure 1 shows the circuit arrangement of an automatic washing machine drive and Figure 2 shows graphs for explanatory purposes.

Figure 1 shows a series-wound commutator motor M connected to terminals R,M*p* of a single-phase alternating voltage system via a controllable semiconductor switch 1 (a Triac) in one of the voltage feed lines. The motor has an armature 2 and an exciter winding 3, these being connected in series during so-called motor operation, i.e. with the armature 2 not short-circuited. Connected between outer connecting terminals 21,22 of the armature and commutator connections 23, 24 is a reversing switch S_1 provided in particular for periodic reversal of direction of rotation of the washing drum during washing operation.

Provided between the outer connecting terminals 21, 22 of the armature is a simple single-pole short-circuiting switch S_2 adapted to be closed during braking operation, so that the armature 2 is short-circuited and, furthermore, the exciter winding 3 is supplied, via the controllable switch 1, with adjustable alternating current from the terminals R,M*p*.

In motor operation proper (washing or spinning), the short-circuited switch S_2 is open and the semiconductor switch is so controlled, via a control stage 4 and a controller 5 which operates, for example, in accordance with the phase-angle control

principle, that a predetermined speed of the washing drum is obtained and maintained. For this purpose, at least one speed actual value signal is supplied to the controller 5. In a braking operation, the short-circuiting switch S_3 is closed and thereby the armature 2 is short-circuited so that a braking effect is achieved and, therewith, the deceleration time or time of transmission of the washing drum between the higher, previously attained operating speed, and the following, lower operating speed can be substantially shortened. Via the speed setting elements which are available to the semiconductor switch 1, namely the control stage 4 and also the controller 5, the exciter current of the exciter winding 3 can be so adjusted as a function of speed that it becomes possible to achieve an optimum relationship between the torque characteristic of the decelerating washing drum braked due to drum friction, and the braking curve of the motor M operating with its armature 2 short-circuited.

Figure 2 shows, in order to make the situation clear, by the full curve *a*, how the braking torque M*b* varies as a function of the speed *n* of the washing drum as the drum slows solely due to drum friction and, by the curve *b*, how the braking torque M*b* varies as a function of *n* due to the drum being braked as a result of solely the closure of the switch S_2 and control of the exciter current. Incidentally, in the latter case, the triggering of the semiconductor switch 1 is such that a constant armature current flows during braking. It will be perceived that the friction braking torque, decreasing with decreasing speed *n*, can be compensated for by the braking torque due to the motor M operating with a short-circuited armature and with its exciter winding supplied via the semiconductor switch 1, this torque correspondingly increasing with decreasing speed. The curve shown by a dot-dash line indicates how the maximum possible exciter current I_{Emax} varies with M*b*, this imposing a limit on the decrease in speed that can be attained by controlling the exciter current.

WHAT WE CLAIM IS:—

1. An electro-motive drive for an automatic washing machine, the drive comprising an AC series-wound commutator motor, provided with controllable semiconductor switch means via which the motor can be coupled with a single-phase supply, there being control means coupled with the switch means for controlling the speed of the motor, and a single-pole switch device connected between outer terminals of the armature of the motor, the drive being such that, to transfer from a higher to a lower speed in use of the drive, the armature is short-circuited by closing the switch device, this device connecting the exciter winding of the motor so that it is fed from the supply via the semiconductor switch means, the exciter current being controllable via the semiconductor switch means for achieving a desired variation of braking torque with speed.

2. A drive according to claim 1, wherein the exciter current is controlled as a function of sped so that the braking torque due to the motor operating with a short-circuited armature and with its exciter winding supplied via the semiconductor siwtch means increases with decreasing motor speed.

3. A drive according to claim 1, wherein the exciter current is controlled so that the braking torque due to the motor operating with a short-circuited armature and with its exciter winding supplied via the semiconductor switch means varies in accordance with a predetermined function of time.

4. A drive according to either of claims 1 and 2, wherein the exciter current, with the armature short-circuited, is controlled so that the armature current is constant during braking.

5. An electro-motive drive for an automatic washing machine, substantially as herein described with reference to the accompanying drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

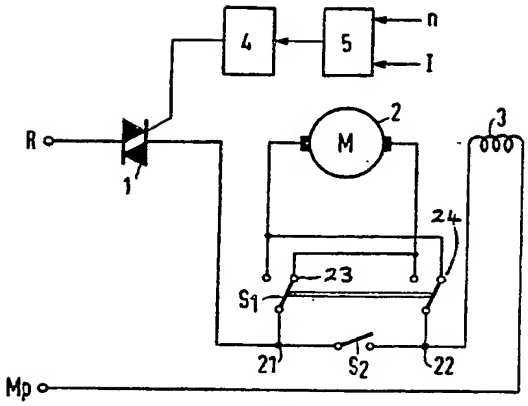

Fig.1

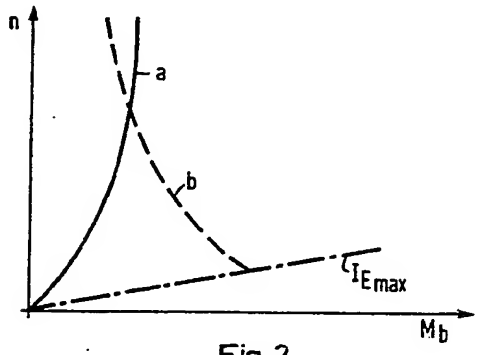

Fig.2